

TITLE OF THE INVENTION

SUBSTRATE AND PLASMA DISPLAY PANEL UTILIZING THE SAME

CLAIM OF PRIORITY

[0001] This application makes references to, incorporates the same herein, and claims all benefits accruing under 35 U.S.C. §119 from an application for *SUBSTRATE AND PDP UTILIZING THE SAME* earlier filed in the Korean Industrial Property Office on 13 March 2001, and there duly assigned Serial No. 12890/2001 by that Office.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to a plasma display panel (PDP), and more particularly, to a substrate having improved partitions to prevent crosstalk between pixels and improved arrangement of phosphor patterns, and a PDP utilizing the same.

Description of the Related Art

[0003] A plasma display panel (PDP) generates light by exciting fluorescent materials or special discharge gases to form an image using the light. The plasma display panels are largely classified into an alternating current (AC) type, a direct current (DC) type, and a hybrid type.

[0004] The conventional AC type PDP includes a transparent front substrate sealed with a rear

1 substrate to form a discharge space, electrodes formed on at least one side of the rear substrate and
2 the front substrate to cause a plasma discharge in the discharge space, and partitions disposed in the
3 discharge space to partition the discharge space and prevent crosstalk between pixels. In the above-
4 described PDP, however, phosphors emitting red light (R), green light (G) and blue light (B), coated
5 in the discharge space partitioned by the partitions, cause a severe difference in luminous efficiency
6 between the respective colors. For example, the luminous efficiency ratio of the R, G and B
7 phosphors is 3:6:1. That is, the luminous efficiency of the B phosphors is very low. To solve this
8 problem, attempts to control a white balance or the coating area of fluorescent materials are being
9 made through adjustment of the magnitude of an image signal. Since the magnitudes of R and G
10 signals are more reduced as compared with a B signal, the display of gray scales of an image may
11 not be properly performed. Also, adjustment of the coating area only exhibits a negligible effect of
12 increasing the luminous efficiency, and causes a smaller discharge margin due to a change in the
13 voltage between discharge cells caused by a change in the gap between electrodes.

14 **[0005]** Partition walls of a plasma display panel are disclosed in U.S. Patent No. 5,967,872 issued
15 to Betsui et al. for *Method for Fabrication of a Plasma Display Panel*, which claims priority from
16 Japanese Laid-open Publication No. hei 09-50768. The separator walls have a zigzag, snaking or
17 meandering shape to form channels having relatively wide discharge cells and relatively narrow
18 connecting portions. According to the PDP having the above-described configuration, while the
19 luminous efficiency can be improved, the white balance characteristics are not improved, which will
20 now be described in more detail.

21 **[0006]** A white balance refers to a condition in which a constant color temperature characteristic

1 is maintained in the periods of 0-255 gray scales irrespective of gray scales. In a PDP, it is quite
2 difficult to maintain a constant color temperature characteristic irrespective of gray scales.
3 Generally, a high color temperature characteristic is exhibited in lower gray scales, and gradually
4 decreasing color temperature characteristics are exhibited in higher gray scales. It is the luminous
5 efficiency ratio of R and G phosphors that is one of factors most sensitive to color temperature
6 characteristic.

7 **[0007]** In the conventional PDP, it is often the case that the luminous efficiency of the G phosphor
8 is increased to enhance the brightness of the PDP. However, this enhancement also causes the color
9 temperature characteristic to be deteriorated. In the zigzag, snaking separator walls of U.S. Patent
10 No. 5,967,872 issued to Betsui et al., the light-emitting area of a discharge cell is so large as to
11 increase the luminous efficiency of a phosphor, exerting a luminance increasing effect. According
12 to this structure, since the sizes of discharge cells coated with R, G and B phosphors are the same,
13 the luminous efficiency ratio of R, G and B phosphors is not so different from that of a conventional
14 striped discharge cell structure. Thus, improvement in color temperature characteristic cannot be
15 attained in every period of 0 to 255 gray scales.

16 SUMMARY OF THE INVENTION

17 **[0008]** It is therefore and object of the present invention to provide a plasma display panel to both
18 improve the luminous efficiency of a blue (B) phosphor, whose luminous efficiency is relatively low
19 in a defined discharge space, and to improve a white balance characteristic.

20 **[0009]** It is another object to improve the color temperature of a plasma display panel along with

1 the luminous efficiency and the white balance characteristics.

2 **[0010]** It is yet another object to prevent a decrease in the opening ratio of the third main
3 discharge spaces since common electrodes and sustaining electrodes are arranged at a boundary
4 between first and second main discharge spaces and a third main discharge space.

5 **[0011]** It is still another object to have a plasma display panel that is easier and less expensive to
6 manufacture.

7 **[0012]** Additional objects and advantages of the invention will be set forth in part in the
8 description which follows and, in part, will be obvious from the description, or may be learned by
9 practice of the invention.

10 **[0013]** To accomplish the above and other objects, a plasma display panel according to an
11 embodiment of the present invention includes a substrate, a dielectric layer formed on a top surface
12 of the substrate, partitions spaced a predetermined distance apart from each other and formed in a
13 snaking or meandering shape to form a plurality of channels having main discharge spaces and
14 auxiliary discharge spaces alternately arranged and connected to each other to form channels and red
15 (R), green (G) and blue (B) phosphors coated on the main discharge spaces in a triangular shape with
16 the G and R phosphors aligned with each other in a horizontal direction.

17 **[0014]** According to another aspect of the present invention, the partitions include first partition
18 portions forming main discharge spaces, second partition portions forming auxiliary discharge
19 spaces, and third partition portions connecting the first and second partition portions, and thicknesses
20 of the first partition portions forming the main discharge spaces where the R and G phosphors are
21 coated are greater than those of the first partition portions forming the main discharge spaces where

1 the B phosphor is coated.

2 **[0015]** According to another embodiment of the present invention, a plasma display panel includes
3 a substrate, a dielectric layer formed on a top surface of the substrate, first partitions disposed in a
4 striped pattern, spaced a predetermined distance apart from each other on the top surface of the
5 dielectric layer and having recessed portions at opposite sides, and second partitions spaced a
6 predetermined distance apart from each other in a snaking shape, forming main discharge spaces in
7 cooperation with the recessed portions and forming auxiliary discharge spaces in cooperation with
8 lateral surfaces of the first partitions adjacent to the recessed portions.

9 **[0016]** According to another aspect of the present invention, red (R) and green (G) phosphors are
10 coated in ones of the main discharge spaces formed by the first and second partitions, and a blue (B)
11 phosphor is coated in ones of the main discharge spaces formed by the adjacent second partitions.

12 According to yet another embodiment of the present invention, a plasma display panel includes a
13 substrate, data electrodes formed on the top surface of the substrate in a predetermined pattern, a first
14 dielectric layer formed on the surface of the substrate to cover the data electrodes, first partitions
15 having a striped pattern spaced a predetermined distance apart from each other on a top surface of
16 the first dielectric layer and having recessed portions at opposite sides, second partitions spaced a
17 predetermined distance apart from each other in a snaking shape, forming main discharge spaces in
18 cooperation with the recessed portions and forming auxiliary discharge spaces in cooperation with
19 lateral surfaces of the first partitions adjacent to the recessed portions, a front plate sealed with the
20 substrate, common electrodes and sustaining electrodes arranged in the main discharge spaces in a
21 non-parallel direction with a direction of the data electrodes on a bottom surface of the front plate,

1 and a second dielectric layer formed on the bottom surface of the front plate to cover the common
2 and sustaining electrodes.

3 BRIEF DESCRIPTION OF THE DRAWINGS

4 [0017] A more complete appreciation of this invention, and many of the attendant advantages
5 thereof, will be readily apparent as the same becomes better understood by reference to the
6 following detailed description when considered in conjunction with the accompanying drawings in
7 which like reference symbols indicate the same or similar components, wherein:

8 [0018] FIG. 1 is an exploded perspective view of a conventional plasma display panel;

9 [0019] FIG. 2 is an exploded perspective view of a plasma display panel according to an
10 embodiment of the present invention;

11 [0020] FIG. 3 is a plan view of the substrate shown in FIG. 2;

12 [0021] FIG. 4 is a cross-sectional view of the substrate shown in FIG. 3; and

13 [0022] FIG. 5 is a plan view of a substrate according to another embodiment of the invention.

14 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 [0023] Turning now to the drawings, FIG. 1 shows partition walls of a plasma display panel such
16 as those disclosed in U.S. Patent No. 5,967,872 issued to Betsui et al. for *Method for Fabrication*
17 *of a Plasma Display Panel*, which claims priority from Japanese Laid-open Publication No. hei 09-
18 50768. As shown in FIG. 1, separator walls 1 have a zigzag, snaking or meandering shape to form
19 channels having relatively wide discharge cells 2 and relatively narrow connecting portions 3.

1 According to the PDP having the above-described configuration, while the luminous efficiency can
2 be improved, the white balance characteristics are not improved.

3 **[0024]** FIGS. 2, 3 and 4 show a plasma display panel (PDP) including a substrate having partitions
4 according to an embodiment of the present invention. A PDP 40 includes a substrate 41, data
5 electrodes 42 formed on a top surface of the substrate 41 in a predetermined pattern (*i.e.*, spaced a
6 predetermined distance apart from and parallel to each other), a first dielectric layer 43 formed on
7 a surface of the substrate 41 to cover the data electrodes 42. Partitions 100 defining discharge spaces
8 are formed on the first dielectric layer 43. The substrate 41 having the partitions 100 is sealed with
9 a transparent front plate 50 by a sealant (not shown) to hermetically close the discharge space. Pairs
10 of common electrodes 51 and sustaining electrodes 52, each having a corresponding bus electrode
11 56 are formed in a predetermined pattern on a bottom surface of the front plate 50 in a direction
12 crossing a direction of the data electrodes 42. At least one pair of the common electrodes 51 and
13 sustaining electrodes 52 are arranged in one discharge space. A second dielectric layer 53 is formed
14 on the front plate 50 to cover the common electrodes 51 and the sustaining electrodes 52 and the
15 corresponding bus electrodes 56. A protective film 54, often made of MgO, is formed on a top
16 surface of the second dielectric layer 53.

17 **[0025]** In the PDP 40 having the aforementioned configuration, the partitions 100 are spaced a
18 predetermined distance apart from each other on the top surface of the first dielectric layer 43. The
19 partitions 100 meander continuously to form a plurality of channels having first, second, and third
20 main discharge spaces 101R, 101G and 101B, and first, second and third auxiliary discharge spaces
21 102R, 102G and 102B. The first, second and third main discharge spaces 101R, 101G and 101B and

1 the first, second and third auxiliary discharge spaces 102R, 102G and 102B are alternately arranged
2 and connected to each other to form channels. R, G and B phosphors are formed in the first, second
3 and third auxiliary discharge spaces 102R, 102G and 102B and first, second and third main discharge
4 spaces 101R, 101G and 101B, respectively, to form a fluorescent layer of the PDP. The respective
5 R, G and B phosphors are arranged such that the R phosphors are aligned with the G phosphors in
6 a horizontal direction. Each of the partitions 100 includes a first partition portion 103 forming a
7 main discharge space, a second partition portion 104 forming an auxiliary discharge space, and a
8 third partition portion 105 connecting the first and second partition portions 103 and 104. A width
9 W1 of the first partition portion 103 is greater than a width W2 of the second or third partition
10 portion 104 or 105. Thus, the area of the third main discharge space 101B, where the B phosphor
11 is coated, is relatively wider than the area of the first or second main discharge spaces 101R or 101G
12 where the R and G phosphors are coated.

13 **[0026]** Here, the B phosphor may further be coated on the partition portions more thickly than the
14 R and G phosphors.

15 **[0027]** In order to increase an opening ratio of the main discharge spaces 101R, 101G, 101B, the
16 common electrode 51 and the sustaining electrode 52 formed on the front plate 50 are preferably
17 arranged on portions corresponding to the third partition portion 105 as shown in FIG. 3. Also, in
18 order to reduce a discharge starter voltage and extend the relative discharge area, auxiliary electrodes
19 51a and 52a, which are positioned in the main discharge space and extend from opposing sides of
20 the common and sustaining electrodes 51 and 52, are formed. The auxiliary electrodes 51a and 52a
21 may be formed of transparent ITO (indium tin oxide) or metal of a mesh shape. The shapes of the

1 auxiliary electrodes 51a and 52a are not limited to those shown in the above-described embodiment
2 and may be embodied in various shapes in consideration of the opening ratio, discharge area and
3 voltage for plasma discharge. Further, the location of the electrodes 51 and 52 need not be as shown,
4 and the auxiliary electrodes 51a and 52a need not be used in all embodiments of the invention.

5 **[0028]** FIG. 5 shows a PDP 100 having partitions according to another embodiment of the present
6 invention, in which the same reference numerals denote the same elements as in the above-described
7 embodiment. As shown in FIG. 5, data electrodes 42 are formed on a top surface of a substrate 41
8 in a predetermined pattern. A first dielectric layer 43 is formed on the top surface of the substrate
9 41 to cover the data electrodes 42. First partitions 110 of a striped pattern having recessed portions
10 111 formed at opposite sides are spaced a predetermined distance apart from each other on a top
11 surface of the first dielectric layer 43. Second partitions 120 forming first and second main
12 discharge spaces 131 and 132 where R and G phosphors are coated are formed at either side of each
13 of the first partitions 110. A third main discharge space 133, where a B phosphor is coated, is
14 formed by the second partitions 120. The second partitions 120 form auxiliary discharge spaces 134
15 and 135 in cooperation with the lateral surfaces of the first partitions 110 adjacent to the recessed
16 portions 111. The second partitions 120 form another auxiliary discharge space 136 between
17 adjacent lateral surfaces of the second partition 120.

18 **[0029]** Here, the first, second and third main discharge spaces 131, 132 and 133, where the R, G
19 and B phosphors, are coated are disposed in a triangular arrangement. Specifically, each color is a
20 corner of the triangle as shown in FIG. 5. The area of the third main discharge space 133, where the
21 B phosphor is coated, is relatively wider than the area of the first or second main discharge space 131

1 or 132. Common electrodes 51 and sustaining electrodes 52 are arranged at the interface between
2 the first and second main discharge spaces 131 and 132 and the third main discharge space 133 on
3 the front plate 50. Like in the above-described embodiment, the common electrodes 51 and
4 sustaining electrodes 52 may further include auxiliary electrodes 51a and 52a extending toward one
5 another from opposing sides thereof, respectively. The common electrodes 51 and sustaining
6 electrodes 52 may be formed of conductive metal without limitation.

7 **[0030]** The aforementioned PDP 100 according to an embodiment of the present invention is
8 driven as follows.

9 **[0031]** First, if a predetermined display data signal is applied to the data electrodes 42 and a
10 scanning pulse voltage is applied to the sustaining electrodes 52, a preliminary discharge occurs
11 within the main discharge space so that wall charges accumulate at ones of the main discharge spaces
12 101R, 101G, 101B. In this state, if a sustaining pulse voltage is applied to the sustaining electrodes
13 52, a sustaining discharge occurs by the wall charges on the protective film 54 on the sustaining
14 electrodes 52. The sustaining discharge continues by alternately applying the sustaining pulse
15 voltage to the common electrodes 51 and the sustaining electrodes 52. Ultraviolet (UV) radiation
16 generated by the sustaining discharge excites the R, G and B phosphors coated on the first, second
17 and third main discharge spaces 101R, 101G and 101B, and visible light generated from these
18 phosphors is displayed on the front plate 50.

19 **[0032]** Another PDP driven based on the above-described operating principle with reference to
20 FIG. 3 includes the partitions 100 formed of a meandering shape, and the first, second and third main
21 discharge spaces 101R, 101G and 101B are defined by the partitions 100. The width W1 of the first

1 partition portion 103 forming the first and second main discharge spaces 101R and 101G where the
2 R and G phosphors are coated is greater than the width W2 of the second or third partition portion
3 104 or 105 forming the third main discharge space 101B where the B phosphor is coated. Thus, the
4 area of the third main discharge space 101B is widened, which compensates for a reduction in the
5 luminous efficiency of the B phosphor, thereby improving a white balance characteristic. In
6 particular, since the B phosphor is formed more thickly than the R and G phosphors, the luminous
7 efficiency of the B phosphor can be further enhanced.

8 **[0033]** The common electrodes 51 and the sustaining electrodes 52 are arranged at the third
9 partition portion 105 as a boundary between the first, second and third main discharge spaces 101R,
10 101G and 101B. Thus, a decrease in the opening ratio of the main discharge spaces 101R, 101G and
11 101B can be prevented by the electrodes 51 and 52. Since the common electrodes 51 and sustaining
12 electrodes 52 have metal auxiliary electrodes 51a and 52a formed to project toward each other, a
13 discharge starter voltage can be reduced by narrowing the gap between the common electrode 51 and
14 the sustaining electrode 52. Also, a sustaining discharge occurring between the auxiliary electrodes
15 51a and 52a made of metal or ITO may spread over the area of the common electrodes 51 and
16 sustaining electrodes 52 existing in the main discharge space, thereby extending a sustaining
17 discharge area.

18 **[0034]** As shown in FIG. 5, the partition structure according to an embodiment of the present
19 invention includes the first partitions 110 having the recessed portions 111 and the second partitions
20 120 disposed at either side of each of the first partitions 110 and having a meandering shape. The
21 third main discharge space 133, where the B phosphor is coated, is formed only by the second

1 partitions 120. That is, the third main discharge space 133 for B phosphor is easily obtained.

2 As described above, in the substrate having the partitions and the PDP utilizing the substrate
3 according to the present invention, degradation in the white balance characteristic due to a difference
4 in luminance among R, G and B phosphors, can be prevented by increasing the B phosphor coated
5 area. Also, the color temperature characteristic can also be improved. Further, since common
6 electrodes and sustaining electrodes are arranged at a boundary between first and second main
7 discharge spaces and a third main discharge space, a decrease in the opening ratio of the main
8 discharge spaces can be prevented.

9 **[0035]** While this invention has been particularly shown and described with reference to preferred
10 embodiments thereof, it will be understood by those skilled in the art that various changes in form
11 and details may be made therein without departing from the spirit and scope of the invention as
12 defined by the claims and their equivalents.